

## TILT STEERING APPARATUS

## CROSS REFERENCE TO RELATED APPLICATION

526  
The application claims priority benefits under 35 USC § 119 of Japanese Patent Application Serial No. 2000-244877 filed on August 11, 2000 and Japanese Patent Application Serial No. 2000-276854 filed on September 12, 2000, the disclosure of which is incorporated by reference.

## BACKGROUND OF The INVENTION

## FIELD OF THE INVENTION

The present invention relates to a tilt adjustable tilt steering apparatus.

## DESCRIPTION OF RELATED ARTS

526  
There is a tilt steering apparatus so adapted that the height of a steering wheel can be changed depending on the physical constitution of a driver, the driving position, or the like. An example of the tilt steering apparatus is a telescopically adjustable tilt steering apparatus in which the position of a steering wheel is adjusted along the axis of a steering shaft.

Conventionally, there has been provided as the tilt steering apparatus one comprising a fixed bracket fixed to a vehicle, a tilt bracket

fixed to a steering column, a supporting shaft penetrating side plates of the fixed bracket and the tilt bracket, a lock lever manually rotated around the axis of the supporting shaft, and a cam mechanism for pressing the side plates of both the brackets as the lock lever is rotated in the locking direction to achieve tilt locking.

However, the operating torque of the lock lever in a case where the tilt locking is achieved is increased. On the other hand, the operating torque of the lock lever in a case where the tilt locking is released is small, so that a feeling of operation is bad.

The present invention has been made in view of the above-mentioned problems, and has its object to provide a tilt steering apparatus capable of obtaining a suitable operating torque of a lock lever and having good operability.

#### SUMMARY OF THE INVENTION

In order to attain the above-mentioned object, in a preferred mode of the present invention, a tilt steering apparatus comprising a tilt adjustable steering column comprises a fixed bracket fixed to a body of a vehicle; a tilt bracket fixed to the steering column; a side plate

provided in the fixed bracket; a side plate provided in the tilt bracket and sliding along the side plate of the fixed bracket at the time of tilt adjustment; a supporting shaft passing through respective insertion holes of the side plates of the fixed bracket and the tilt bracket; a lock lever rotatable in the locking direction and the locking releasing direction around an axis of the supporting shaft and rotated in the locking direction to lock the steering column to an adjusted tilt position; and a cam surface and a cam follower which are relatively rotated while being brought into sliding contact with each other as the lock lever is rotated. The cam surface includes a plurality of slopes corresponding to a rotation stroke position of the lock lever. The cam surface presses the cam follower as the lock lever is rotated in the locking direction so that the side plates of both the brackets are pressed against each other, resulting in the steering column being locked at the adjusted tilt position.

In this mode, the operating force of the lock lever in a case where the lock lever is locked can be reduced without making the range of the

operating angle of the lock lever so large by providing the plurality of slopes.

It is preferable that the tilt steering apparatus further comprises means for increasing the operating torque of the lock lever at the front of a stroke in the locking releasing direction of the lock lever, the cam surface and the cam follower constituting means for increasing the operating torque of the lock lever.

The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a partially broken front view of a tilt steering apparatus according to an embodiment of the present invention;

Fig. 2 is a partially broken side view of a lock lever and a portion to which the lock lever is attached;

Fig. 3A is a front view of a cam including a cam surface, and Fig. 3B is a front view of a surface of a cam follower opposite to the cam

surface;

Fig. 4 is a cross-sectional view schematically showing a cam and a cam follower;

Fig. 5 is a cross-sectional view of a cam in a tilt steering apparatus according to another embodiment of the present invention;

Fig. 6A is a front view of a surface, opposite to a cam follower, of the cam shown in Fig. 5, and Fig. 6B is a cross-sectional view taken along a line 6B - 6B shown in Fig. 6A;

Fig. 7A is a front view of a cam follower surface opposite to the cam shown in Fig. 5, and Fig. 7B is a cross-sectional view taken along a line 7B - 7B shown in Fig. 7A;

Figs. 8A and 8B are cross-sectional views sequentially showing the operations of a cam and a cam follower in a case where a lock lever is fastened in order to achieve tilt locking in the embodiment shown in Fig. 5;

Figs. 9A and 9B are cross-sectional views sequentially showing the operations of a cam and a cam follower in a case where a lock lever is loosened in order to release tilt locking in the embodiment shown in Fig. 5;

Fig. 10 is a cross-sectional view of a cam

and a cam follower in another embodiment of the present invention;

Fig. 11 is a cross-sectional view of a cam and a cam follower in still another embodiment of the present invention;

Fig. 12 is a cross-sectional view of a cam and a cam follower in a further embodiment of the present invention; and

Fig. 13 is a cross-sectional view of a cam and a cam follower in a still further embodiment of the present invention.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the present invention will be described while referring to accompanying drawings.

Fig. 1 is a longitudinal sectional view of a steering column in a tilt telescopic steering apparatus according to an embodiment of the present invention, and Fig. 2 is a partially broken side view of a lock lever and a portion to which the lock lever is attached. Referring to Fig. 1, a tilt telescopic steering apparatus 1 (hereinafter merely referred to as a steering apparatus 1) comprises a steering column 2 for supporting a steering shaft 1 having a steering

*work*  
 wheel fixed to its upper end in the axial direction so as to be rotatable.

The steering column 2 comprises a tube 3 (corresponding to an upper jacket) for supporting the steering shaft 1 so as to be rotatable and a tilt bracket 4 fixed to the tube 3. The tilt bracket 4 is in a groove shape opening downward. A vertically long hole 7 extending along the length of the steering column 2 is formed in left and right side plates 5 and 6 of the tilt bracket 4.

*35*  
 A fixed bracket 8 is fixed to a vehicle, and is in the shape of a groove opening downward comprising a pair of side plates 9 and 10 opposite to each other and an upper plate 11 connecting intermediate portions at upper ends of the side plates 9 and 10 to each other. A vertically long hole 12 in the shape of a circular arc is formed in each of the side plates 9 and 10. Reference numerals 13 and 14 denote mounting stays formed by folding upper edges of parts of the side plates 9 and 10 outward. The fixed bracket 8 is fixed to the vehicle by a bolt passing through a screw insertion hole formed in each of the mounting stays 13 and 14, which is not illustrated.

50

referring to Fig. 2, the longitudinal main unit 41. A cam 22, described above, is connected to a cam 22, described above, integrally rotatable is provided with the main unit 41, and a gear driver is provided at the

Referring to Fig. 2, the lock lever 16 has a longitudinal main unit 41. A connecting section 23 connected to a cam 22, described later, so as to be integrally rotatable is provided at one end of the main unit 41, and a grip 42 to be gripped by a driver is provided at the other end of the



11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1041 1042 1043 1044

The supporting shaft 15 is composed of a bolt having a head 17, a body 18 composed of a circular cylinder, and a screw portion 19. The body 18 penetrates the side plates 5 and 6 of the bracket 4 and the side plates 9 and 10 of the bracket 8, and the head 17 has a plain washer 20 interposed between the head 17 and an outer surface of the side plate 10 of the fixed bracket 8.

On the other hand, the screw portion 19 of the supporting shaft 15 and a part of the body 18

connecting therewith project outward from the side plate 9 of the fixed bracket 8, and an annular cam follower 21 is fitted in a part of the body 18. The cam follower 21 is brought into contact with an outer surface of the side plate 9 of the fixed bracket 8. Further, the cam follower 21 has a projection inserted through the vertically long hole 12 of the side plate 9. Consequently, the rotation of the supporting shaft 15 around a center axis C is bound by the side plate 9 of the fixed bracket 8.

An annular cam 22 which is brought into contact with the cam follower 21 is fitted in the screw portion 19 so as to be relatively rotatable. The connecting section 23 of the lock lever 16 is connected to the cam 22 so that the lock lever 16 and the cam 22 are integrally rotated. A nut 24 with a flange is screwed into the screw portion 19. The nut 24 positions the cam 22 along the axis of the supporting shaft 15 through the annular shim 25 and the connecting section 23 of the lock lever 16. The inner periphery of the annular connecting section 23 may be in a polygonal shape such as a hexagonal shape or a shape having a width across flat on its circumference.

The shim 25, the connecting section 23, the cam 22, and the cam follower 21 are interposed between the side plate 9 of the fixed bracket 8 and the nut 24. When the lock lever 16 is rotated, the cam 22 is rotated relative to the cam follower 21, so that the cam follower 21 is pressed against the side plate 9 upon advancing and retreating along the center axis C of the supporting shaft 15 or the pressing thereof is released, thereby achieving tilt locking and telescopic locking and releasing the locking.

As shown in Fig. 3A, a pair of a first positioning section 26 for positioning the cam follower 21 at the time of releasing locking and a second positioning section 27 for positioning the cam follower 21 at the time of locking are provided so as to be opposite to each other with a center axis of the cam 22 (i.e., the center axis C of the supporting shaft 15) on a surface 22a, opposite to the cam follower 21, of the cam 22.

Referring to Figs. 3A and 4, a cam surface 28 is formed between the first and second positioning sections 26 and 27 which correspond to each other. In Fig. 4, an arrow X indicates the direction in which the cam follower 21 moves

relative to the cam 22 when the lock lever 16 is stroked in the locking direction. On the other hand, as shown in Fig. 3B, the positioning sections 26 and 27 of the cam 22 and a pair of projections 31 in the shape of a stand which are brought into sliding contact with a cam surface 28 are formed on a surface 21a, opposite to the cam 22, of the cam follower 21.

As shown in Fig. 4, the cam surface 28 comprises a first slope 29 relatively steeply inclined and a second slope 30 relatively gently inclined, and the second slope 30 corresponds to the rear of a stroke in the locking direction of the lock lever.

According to the present embodiment, the plurality of slopes 29 and 30 are provided on the cam surface 28, thereby making it possible to reduce the operating force of the lock lever 16 without so enlarging the operating angle of the lock lever 16.

Particularly, the cam surface 28 is provided with the second slope 30 relatively gently inclined in correspondence with the rear of a stroke in the fastening direction of the lock lever 16 whose operating torque is liable to be

increased. Consequently, the lever ratio of the lock lever at the rear of the fastening stroke (corresponding to the ratio of the amount of displacement of the cam follower 21 to the increment of the operating angle of the lock lever) can be increased. As a result, the operating torque can be reduced, thereby making it possible to significantly improve the operability of the lock lever 16.

In the above-mentioned embodiment, the cam surface may be provided with three or more slopes which differ in inclination, for example. In order to smooth the operation, the adjacent slopes may be continued by a smooth curve, or the whole of the slopes may be a smooth curve.

Referring now to Fig. 5, the cam 22 has a cylindrical main unit 59 having a center hole 58 through which the supporting shaft 15 is inserted. In the main unit 59, a cam surface 31 is formed on its opposite surface 60 corresponding to the cam follower 21, and a connecting boss 33 is formed on a rear surface 32 of the opposite surface 60. A pair of flat surfaces having a width across flat, for example, is formed on a peripheral surface of the

connecting boss 33. The flat surfaces are engaged with the connecting section 23 of the lock lever 16, so that the lock lever 16 and the cam 22 can be integrally rotated.

Referring to Fig. 5 and Fig. 6A which is a front view of the opposite surface 60, a plurality of recesses 34 forming a fan shape which are equally spaced in the circumferential direction are formed on the opposite surface 60, and a bottom surface of each of the recesses 34 forms a cam surface 31.

Referring to Figs. 6A and 6B, one of a pair of inner sidewalls of the recess 34 opposite to the cam 22 in the circumferential direction constitutes a first positioning section 35 for positioning the cam follower 21 at the time of releasing locking, and the other thereof constitutes a second positioning section 36 for positioning the cam follower 21 at the time of locking.

Referring to Fig. 6B, the cam surface 31 is formed between the first and second positioning sections 35 and 36. The cam surface 31 comprises a flat portion 44, a first forward inclined slope 37 relatively steeply inclined, a second forward

inclined slope 38 inclined more gently than the first slope 37, and a third slope 39 serving as an inverse slope inclined in the opposite direction to the first and second slopes 37 and 38. The adjacent slopes are continued by a smooth curve. The inverse slope constituting the third slope 39 constitutes means for increasing torque at the time of releasing, and constitutes a slope adjusting section for adjusting the operating torque of the lock lever at the time of fastening.

The third slope 39 is positioned at the rear of the fastening stroke of the lock lever. An angle of inclination A to a plane perpendicular to a center axis C1 of the cam 22 is set to approximately  $1^\circ$ , for example (which may be in the range of  $0.5^\circ$  to  $1.5^\circ$ ), and a top 40 is formed between the second slope 38 and the third slope 39.

On the other hand, referring to Figs. 7A and 7B, a plurality of projections 46 forming a shape being trapezoidal in cross section which are brought into sliding contact with the cam surface 31 of the cam 22 are equally spaced in the circumferential direction on a surface 45, opposite to the cam 22, of the cam follower 21.

5/26/2019

Particularly referring to Figs. 8A and 8B, the third slope 39, serving as a slope adjusting section, which is an inverse slope but is hardly inclined is provided on the cam surface 31 in correspondence with the rear of the stroke in the fastening direction of the lock lever 16 whose operating torque is liable to be increased. Consequently, the lever ratio of the lock lever at the rear of the fastening stroke



[illegible]

Fig. 10 is a cross-sectional view schematically showing a cam and a cam follower in

another embodiment of the present invention. Referring to Fig. 10, the present embodiment differs from the embodiment shown in Fig. 9A in that the third slope 39 in the embodiment shown in Fig. 9A is inclined in the opposite direction to the first and second slopes 37 and 38, while a third slope 48 serving as a slope adjusting section in the present embodiment is made inclined in the same direction as first and second slopes 37 and 38 (that is, forward inclined). An angle of inclination D of the third slope 48 is set to  $1^{\circ}$  (which may be in the range of  $0.5^{\circ}$  to  $1.5^{\circ}$ ). In the present embodiment, the cam follower surface 47 constitutes means for increasing torque at the time of releasing. Other constituent elements are the same as those in the embodiment shown in Fig. 9A, and are assigned the same reference numerals and hence, the description thereof is not repeated.

According to the present embodiment, the same function and effect as those shown in Fig. 9A, and the operating force of the lock lever 16 at the time of fastening can be reduced.

The third slope 48 and the cam follower 47 are inclined in opposite directions, and their


respective angles of inclination are made different from each other ( $A \neq B$ ). When the lock lever 16 is operated in the direction in which locking is released, therefore, an edge 49 of a cam follower 47 serving as means for increasing torque at the time of releasing is cut into the third slope 48. Consequently, the operating torque at the time of releasing can be increased to improve a feeling of operation of the lock lever at the time of releasing. In the present embodiment, the cam follower surface 47 may be a portion having no slope.

The present invention is not limited to the above-mentioned embodiments. Various changed modes are considered.

For example, in the embodiment shown in Fig. 9B, the cam follower surface 47 may be brought into contact with the third slope 39 of the cam surface 31 at an edge 49, as shown in Fig. 11, by making an angle of inclination B of the cam follower surface 47 larger than an angle of inclination A of the third slope 39 of the cam surface 31 ( $B > A$ ).

In the embodiment shown in Fig. 9B, a portion having no slope 50 serving as a slope adjusting

section may be provided in place of the third slope 39 of the cam surface 31, as shown in Fig. 12, by reducing the angle of inclination of the third slope 39 to zero ( $A = 0$ ).

*sp  
sr*  In an embodiment shown in Fig. 12, a recess 52 concaved by providing a step 51 may be provided at the rear of a fastening stroke of the portion having no slope 50, as shown in Fig. 13, the angle of inclination B of the cam follower surface 47 may be also reduced to zero ( $B = 0$ ) to have no slope, and a projection 53 fitted in the recess 52 may be provided at the rear of the fastening stroke of the cam follower surface 47. Also in this case, when the lock lever 16 is operated in the releasing direction, the projection 53 moves beyond the step 51, so that contact surface pressure between the cam surface 31 and the cam follower surface 47 is increased once, thereby making it possible to increase the operating torque at the time of a lock releasing operation.

In each of the embodiments, the cam surface may be provided with a larger number of slopes which differ in inclination. Further, in order to smooth the operation, the adjacent slopes (or the slope and the portion having no slope) may be

